Glenohumeral joint: internal and external rotation range of motion in javelin throwers

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Abstract

***Objective*—To assess differences in glenohumeral joint rotatory range of movement in javelin throwers between the throwing and non-throwing arm.**

***Method*—A universal 360° goniometer was used to assess glenohumeral joint external and internal rotation range in 90° of shoulder abduction in a group of ten senior international javelin throwers.**

***Results*—Both arms had significantly greater degrees of external than internal rotation ($p<0.01$), and the throwing arm had significantly greater range of external rotation than the non-throwing arm ($p<0.01$).**

***Conclusions*—The presence of an excessive range of external rotation in the throwing shoulder has the potential to increase eccentric load on the rotator cuff muscles and strain on the passive restraints of the glenohumeral joint. Both of these factors have been implicated in the pathological processes leading to injury in the overhead throwing athlete.**

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Keywords: overhead throwing athlete; javelin throwing; glenohumeral joint; range of movement

Athletes whose sport involves an overhead throwing action are prone to injuries which differ from those of the non-throwing population.[1] Injuries related to throwing sports are commonly seen in sports injuries clinics; 75% involve the upper extremity with most involving the glenohumeral joint.[2]

The throwing athlete exhibits certain unique physical characteristics at the shoulder joint, such as hypermobility of the anterior shoulder capsule, excessive external rotation, hypomobility of the posterior capsule, limited internal rotation, and general ligamentous instability of the glenohumeral joint.[3] In throwers, excessive external rotation is regularly present, often at the expense of limited internal rotation.[4] Limitation of internal rotation is often a manifestation of posterior capsule tightness, which increases both the magnitude and timing of anterior translation and shear forces at the glenohumeral joint during flexion.[5] Excessive external rotation, principally in the cocking phase of a throw, could place excessive eccentric loads on the rotator cuff. This repetitive loading can lead to microtrauma and eventually failure of the tendons.[6]

The aim of the study was to assess the range of external and internal glenohumeral joint rotation in overhead throwing athletes (javelin throwers) in order to gauge any imbalances in range of movement between external and internal rotation and the throwing and non-throwing arm, in the light of their potential to create pathological changes in the shoulder structures. An on line search of the literature (Medline and Sports Discus) revealed no previous studies describing range of movement in this population group.

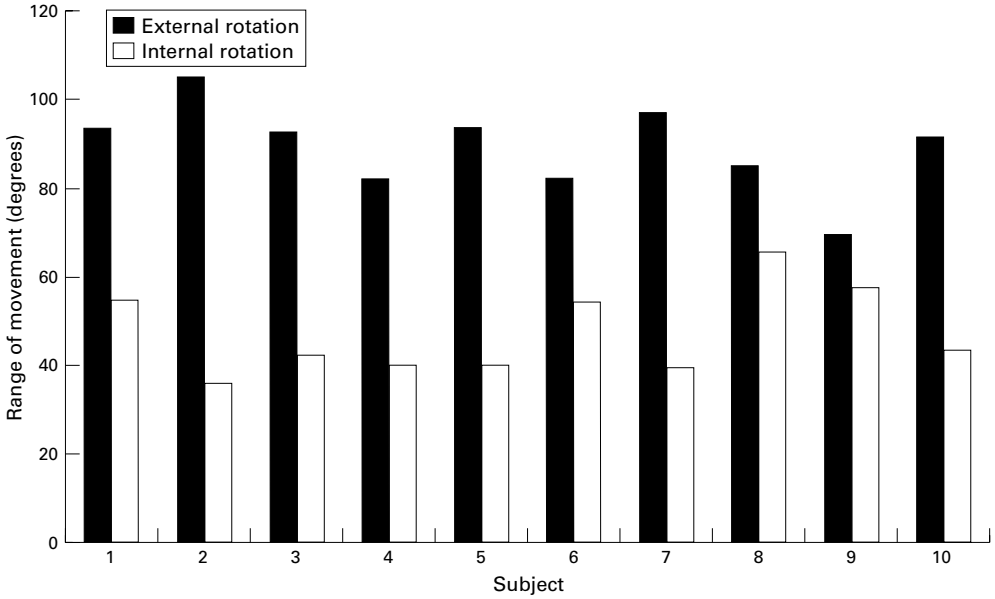

Figure 1 Glenohumeral joint rotation of the throwing arm.

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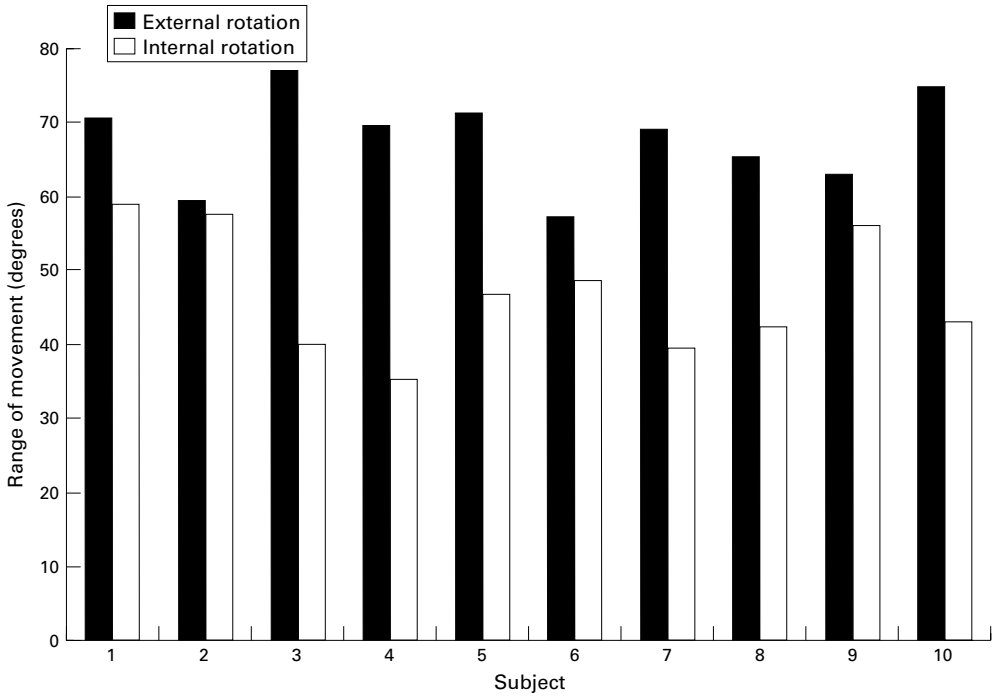

Figure 2 Glenohumeral joint rotation of the non-throwing arm.

Method

SUBJECTS

Ten members of the senior Great Britain javelin squad (two women and eight men) were measured for their active range of shoulder internal and external rotation. All participants were right handed throwers.

PROCEDURE

Range of movement was tested using a standard 360° goniometer with scales marked in 1° increments. All testing took place with the subject in a supine position with the arm positioned in 90° of glenohumeral abduction, elbow flexed to 90° and the forearm vertical—that is, the neutral position for rotation.[7] The goniometer axis was aligned with the long axis of the humerus, the distal tip of the olecranon being used as the superficial landmark. The stationary arm of the goniometer was placed in a vertical position, with the moving arm aligned with the lateral aspect of the ulna.

From a zero rotation position, subjects were asked to externally rotate their shoulder maximally. Stabilisation of the scapulothoracic joint was provided by the tester via a posteriorly directed force from the tester's hand on the coracoid and anterior aspect of the acromion, to prevent scapular protraction or elevation. Once the subject had achieved end of range, the angle was recorded. The identical method was repeated with subjects moving their shoulder into internal rotation. All measurements were made by a single physiotherapist experienced in goniometric measurement.

For each direction three measurements were taken and the mean measurement calculated. Both the throwing and non-throwing arms were measured in this manner. Two way repeated measures analysis of variance was used to assess the difference between throwing and non-throwing arms and internal and external rotation on each side.

Range of movement of the glenohumeral joint in this study was measured using a universal 360° goniometer. The use of the universal goniometer for measuring range of movement is long established and has been found to have high intratester reliability.[8] Goniometric measurement of the glenohumeral joint is difficult because of the multijoint nature of the shoulder complex[5]; however, reliability of measurement ranging from 0.87 to 0.99 has been reported.[9] In general, the literature would appear to indicate that the goniometer is a reliable measuring tool, especially when used by a single experienced tester.

Results

Figures 1 and 2 show the range of movement for the throwing and non-throwing arms respectively. For all subjects, external rotation was greater than internal rotation, regardless of arm. Both the throwing and non-throwing arms had statistically significantly greater degrees of external than internal rotation ($p<0.01$). The throwing arm had significantly greater range of external rotation than the non-throwing arm ($p<0.01$), but no significant difference was recorded between sides for internal rotation ($p>0.05$).

Discussion

It is not uncommon for the overhead throwing athlete to exhibit a difference in range of movement between the two shoulders, with the throwing arm exhibiting greater motion into external rotation with the shoulder in 90° of abduction.[10] This view was supported by the findings of this study with significant bilateral differences in degree of external rotation.

Boublik and Hawkins[4] reported that excessive external rotation range occurred at the expense of internal rotation range on examination of the overhead throwing athlete, and the present study found significant differences between the ranges of external and internal shoulder rotation, concurring with their findings. Litchfield *et al*[11] noted that the throwing arm had a reduced range of internal rotation. However, this study did not find this to be the case, with no significant bilateral differences in range of internal shoulder rotation. This may be because Litchfield *et al*[11] were reporting findings from a variety of overhead throwing athletes whereas only a single population group was used in the present study.

The occurrence of an excessive range of external rotation may be a product of a successful training programme to increase movement and thus the range over which force can be applied to the javelin. Therefore hypermobility could be a function of a successful throwing technique; however, no study to date has equated range of movement with throwing distance.

It has been stated previously[3] that excessive external rotation in the cocking phase of a throw has the potential to increase eccentric loads on the rotator cuff muscles. Fatigue and a reduction in the ability of the rotator cuff to control the excessive high velocity external rotation has been stated to allow the humeral head to be translated anteriorly.[1] The implication of this is that excessive external shoulder rotation can create excessive anterior humeral head displacement[10] This concurs with the conclusion of Hackney[1] that shoulder pain in the overhead throwing athlete is often caused by subtle subluxation of the humeral head and concurrent strain of the glenohumeral joint restraints, rather than primary impingement.

Cadaveric studies have shown the main constraint to external rotation in the abducted joint to be the inferior glenohumeral ligament.[12] Excessive range of motion in this direction would therefore increase the load on this structure. Karduna and his colleagues[13] found that during active motions, in the above direction, additional force was provided by the rotator cuff muscles to compress the humeral head into the glenoid cavity. This force helps to offset any tension developed in the capsular ligaments. Excessive range may generate pathological changes in the rotator cuff tendons as they are lengthened with eccentric contraction of the muscles to control excessive external rotation. Changes may occur in the capsular ligaments as they are progressively lengthened allowing greater translation of the humeral head. With repetitive throwing, fatigue may occur and the muscles of the rotator cuff become less able to control external rotation. If the muscle forces are absent, considerably larger rotational range and translation are possible[13] increasing the load on the inferior glenohumeral ligament, chronic lengthening of this ligament leading to increased humeral head translation, instability, and impingement.

The present study describes significantly greater glenohumeral joint external rotation in the throwing shoulder of international standard javelin throwers. A review of the literature appears to indicate that this has the potential to create pathological changes within the support structures of the glenohumeral joint. Future work should include longitudinal studies, to determine whether excessive range of movement increases injury incidence, and isokinetic studies into eccentric strength at the end of range, to measure the ability to control the excessive joint motion.

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